ELECTRON EXCITATION CROSS SECTIONS FOR THE *S II* TRANSITIONS $3s^2 3p^3\ {}^4S^o \rightarrow 3s^2 3p^3\ {}^2D^o, {}^2P^o$ and $3s3p^4\ {}^4P$

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Emission lines from excited *S II* are regularly detected in a wide variety of astronomical objects, including the Io torus, Sun, planetary nebulae, H II regions, Seyfert galaxies, and supernova remnants. Experimental and theoretical collisional excitation cross sections are reported here for the observed transitions $3s^2 3p^3\ {}^4S^o \rightarrow 3s^2 3p^3\ {}^2D^o, {}^2P^o$ and $3s3p^4\ {}^4P$ in *S II*. The transition wavelengths (energies) are 6716 Å (1.85 eV), 4069 Å (3.05 eV), and 1256 Å (9.87 eV), respectively. In the experiments, use is made of the energy-loss, merged-beams method[1,2]. The metastable fraction of the *S II* beam is assessed and minimized. The contribution of elastically-scattered electrons is reduced by the use of lowered solenoidal magnetic field, use of a modulated radiofrequency voltage on the analyzing plates, and retarding grids to reject the elastically-scattered electrons with larger Larmor radii. For each transition, comparison is made between present experiment and 19-state *R*-matrix calculation, and with three previous close-coupling calculations[3,4,5].

Shown in Fig. 1 for the lowest-lying, forbidden ${}^4S^o \rightarrow {}^2D^o$ transition are present experimental results, with comparisons to four theoretical calculations: the present 19-state close-coupling (CC) calculation, a 6-state CC calculation[3], a 12-state CC calculation[4], and an 18-state CC calculation[5]. One finds general excellent agreement among the experiment and theories, from threshold to 6 eV (experiment-theories) and 10 eV (theories alone).

In Fig. 2 are presented results for the second forbidden ${}^4S^o \rightarrow {}^2P^o$ transition. Here one finds considerable discrepancy in the location and cross section of the peak. Experiment favors results in the 18-state and 19-state CC theories, while the 12-state and 6-state theories differ in shape, and give about one-half the experimental cross section.

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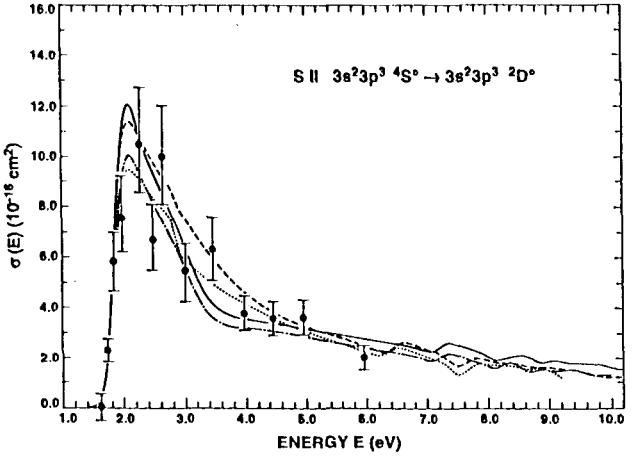

Figure 1. Experimental (filled circles) and theoretical cross sections for excitation of the ${}^4S^o \rightarrow {}^2D^o$ transition. Theoretical results are convoluted with a 250 meV (FWHM) electron-energy width: solid line, present 19-state *R*-matrix calculation; dotted line, Ref. 3; dashed line, Ref. 4; long-short dashed line, Ref. 5.

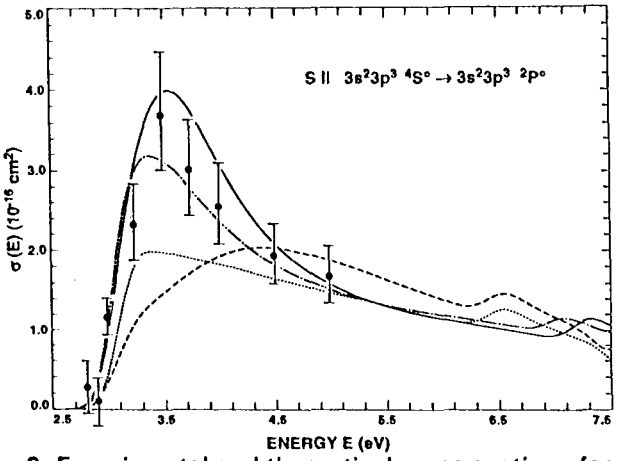

Figure 2. Experimental and theoretical cross sections for excitation of the ${}^4S^o \rightarrow {}^2P^o$ transition. Theoretical results are convoluted with a 250 meV (FWHM) electron-energy width. Notation for the theories is the same as in Fig. 1.